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Responsive properties of alginates in aqueous solutions: Influence of salts on the Gel-Sol-Gel transition

Dominique Hourdet
ESPCI Paris, France

Associating polymers have known a large development during the last decades due to their high performances as thickeners in aqueous media with important applications in various domains like oil recovery, cosmetics or paints. With time the systems become more efficient, even smart as they are able to change their properties under controlled environmental conditions. This is the case of responsive polymers1 which respond to stimuli like salt, pH, temperature, light or external fields. Under controlled conditions, these systems readily form physical networks or nanostructures which offer wide potentialities in biomedical engineering. In this context, biopolymers have an important role to play and we are currently developing a platform of responsive polysaccharides2-5. In this work, new thermoassociative copolymers have been prepared by grafting responsive polymers, characterized by a LCST-type phase transition, onto a rich mannuronic alginate backbone. Their solution properties were studied by differential scanning calorimetry and dynamic rheology. In pure water, the aggregation process of polymer side-chains above their LCST is weakened by electrostatic repulsions taking place between alginate backbones and only moderate thermothickening properties are observed. The responsive behavior of copolymer solutions can be largely improved by increasing the ionic strength and decreasing the electrostatic repulsions. In these conditions we show that alginate chains are very sensitive to the nature of monovalent cations and can selfassemble upon cooling in certain conditions. In the case of grafted copolymers, the superposition of these two associating mechanisms leads to an original double transition upon heating with a reversible gel-sol-gel behavior.

Dominique.hourdet@espci.fr